

NIST Tests Supporting Biometric Identification Applications

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National Institute of Standards and Technology (US),
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National Security Through Biometric Collaboration: A Roadmap To Tomorrow
Sheraton National, Arlington VA, February 23-24, 2011



Overview

- » Chapter 1. Biometric versatility
- » Chapter 2. NIST Role
- » Example NIST outputs
 - Chapter 3. Face Recognition
 - Chapter 4. Iris Recognition

Chapter I :: Uses of Biometrics

Biometric Versatility

Tactical Biometrics :: Versatility

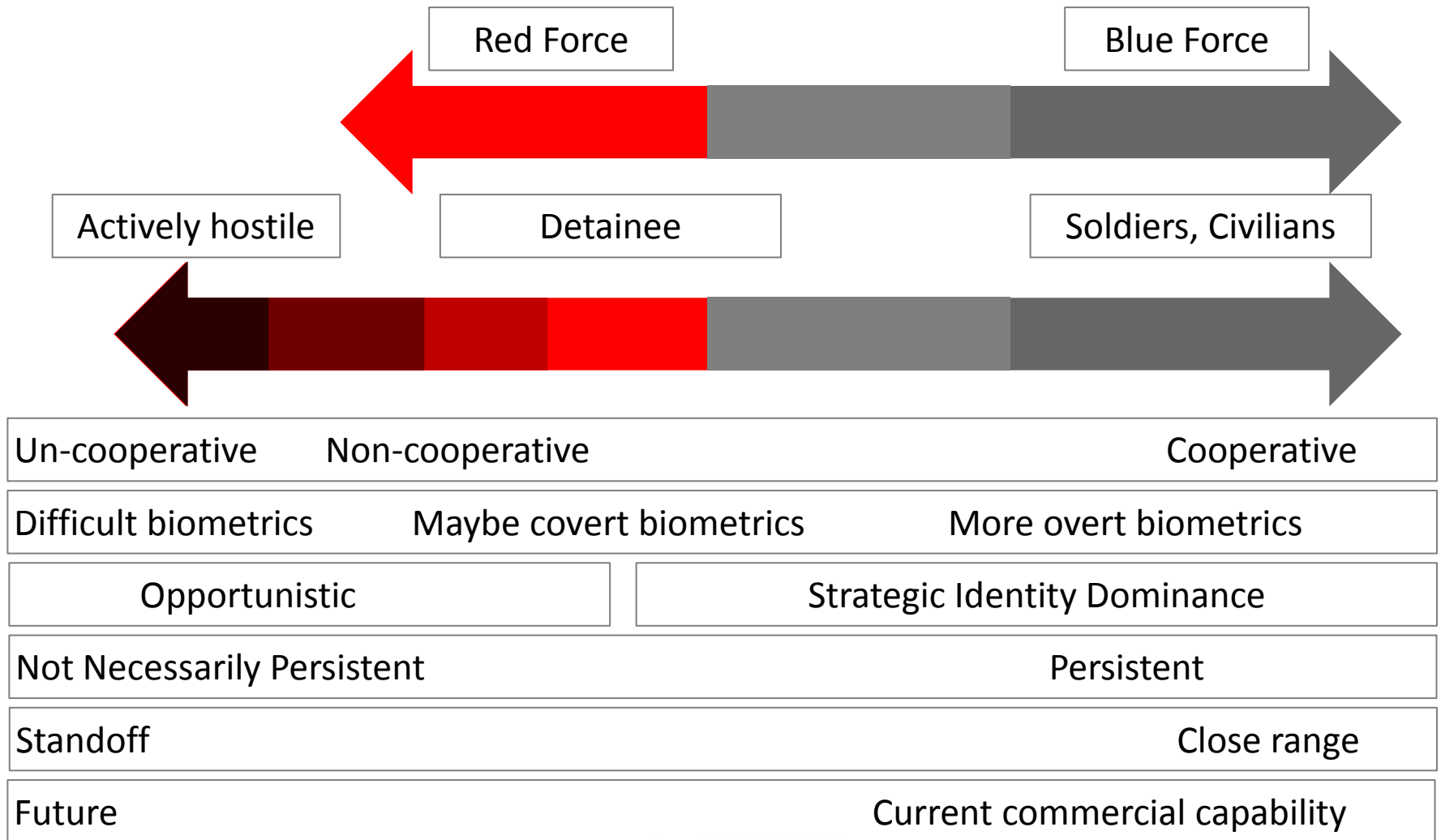
1:1 Authentication :: Is he who he claims to be?

- » Credential issuance
 - Bind ID to person who has been submitted to background check
- » Access control
 - Physical access
 - Logical access

1:N Identification :: Who is she?

- » Unique ID
 - Binding unique IDs and biometrics
- » Duplicate detection
 - Identity fraud, visa, driving license
- » Background check
 - Against criminal db, for example
- » Watchlist - lookout
 - Surveillance
- » Role-based access control
 - Token-less authentication
- » Forensic applications
 - Latent collection
 - Crime scene video

Foe, Friend and Everything In Between and Beyond :: The Role of Biometrics



Chapter II :: NIST Activities in Biometrics

About NIST

» National Institute of Standards + Technology

- Part of Department of Commerce
- Non-regulatory
- Non-policy
- Charter, since 1901, is to support US Industry via
 - Measurement, Standards, Calibration, SRMs, SRDs
- Bias toward transparency, publication
- Write specifications for government IT systems
 - Federal Information Processing Standards (FIPS) are legally binding under FISMA legislation.

About Biometrics at NIST

» Information Technology Laboratory

- Security Division, ~ 2 FTE
- Information Access Division, ~ 24 FTE

» Biometrics

- Fingerprint, Latent, Iris, Face, Speaker, DNA
- Testing – performance , usability, reliability, interoperability
- Testing standards – for technology, operational, scenario
- Data interchange Standards – for interoperable law enforcement, for credentials, for networks
- Research – Performance evaluation, Metrology, Security, Forensics, Image Quality, Multimodal fusion, Multi-sample fusion, Scalability, Face Recognition, Iris recognition,

NIST Programs Supporting Applied Biometrics

Standards

- » Face Recognition
 - ANSI/NIST Type 10
 - ISO/IEC 19794-5
- » Iris Recognition
 - ANSI/NIST Type 17
 - ISO/IEC 19794-6
- » Fingerprint minutiae
 - INCITS 378
 - ISO/IEC 19794-2, A/N Type 9
- » Speaker
 - ANSI/NIST Type X (Future)
 - ISO/IEC 19794-13
- » Latent fingerprint
 - ANSI/NIST Type 9 EFS
- » Fingerprint
 - ANSI/NIST Type 14



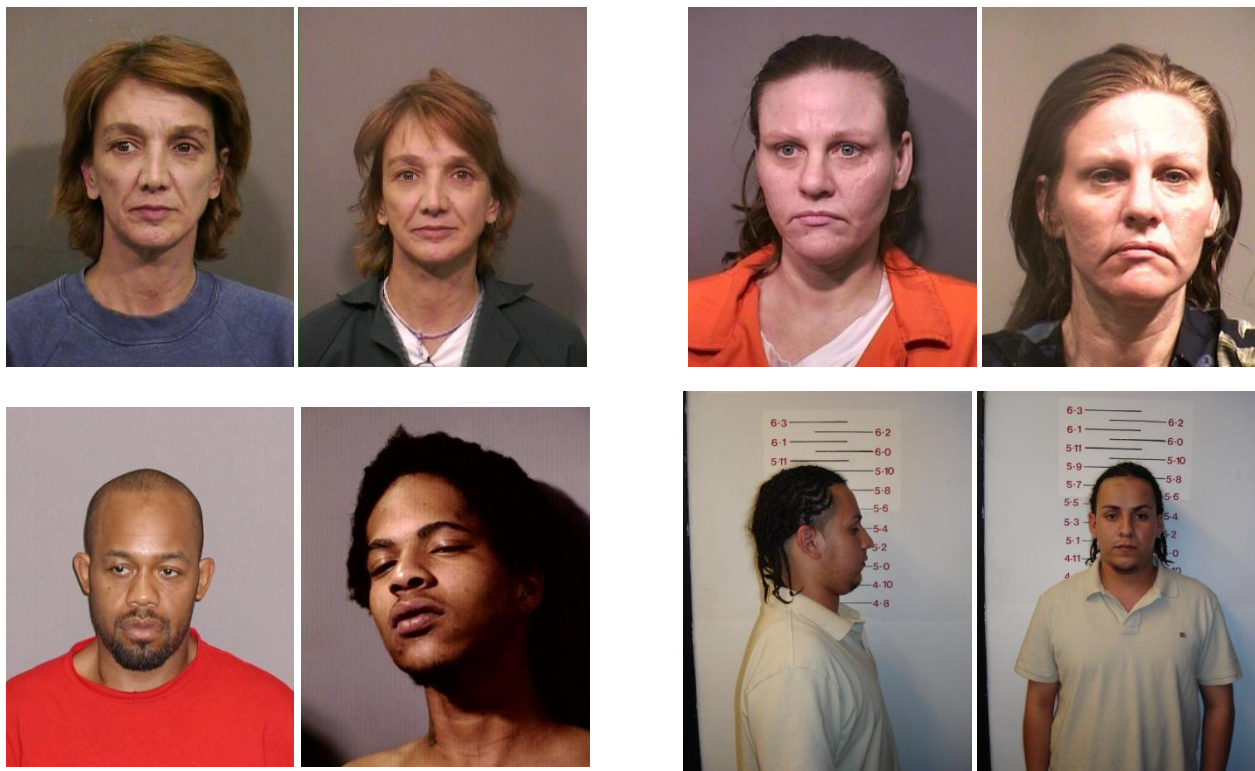
Testing

- » FRVT / MBE / FERET
 - 1:1, 1:N Face Recognition
 - 1997 – 2011
- » IREX (Iris Exchange) 
 - 1:1, 1:N Iris Recognition, Quality
 - 2008, 2010, 2011
- » MINEX (Minutia Exchange) 
 - 1:1 on card, 1:1 off card
 - 2005 – 2011
- » SRE (Speaker Rec. Evaluation)
 - 1997 – 2011
- » ELFT (Latent Fingerprint Tech)
 - 2007 – 2011
- » PFT (Proprietary Templates)
 - 2003 – 2011

Chapter II :: Face Recognition

Selected Results from the 2D Still Image
Track of the Multiple Biometric Evaluation

Law Enforcement (LEO) Images



Fully public sample dataset is available: *Multiple Encounter Deceased Subject Database I+II*, NIST Special Database 32, December 2009.

Webcam :: What mugshot standards?



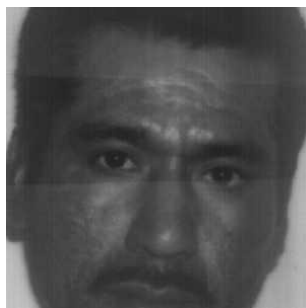
Background impedes face detection and correct exposure of face



Subject too far from camera, gives low resolution.



Eyes closed?
Extreme pitch angle
Too close, gives distortion.



Cropped chin.
Photo-of-photo.
Scanning noise.

Not collected with any attention to mugshot standards.

ISO/IEC 19794-5 :2005+
Amd/1

ANSI/NIST ITL 1-2007,
Annex H, Best Practice
Recommendation For
The Capture Of
Mugshots, Version 2.0,
September 23, 1997

Detect and Fix During Capture

- » Pose
- » Facial expression
- » Eyes closed

Detect and Cannot Fix Immed

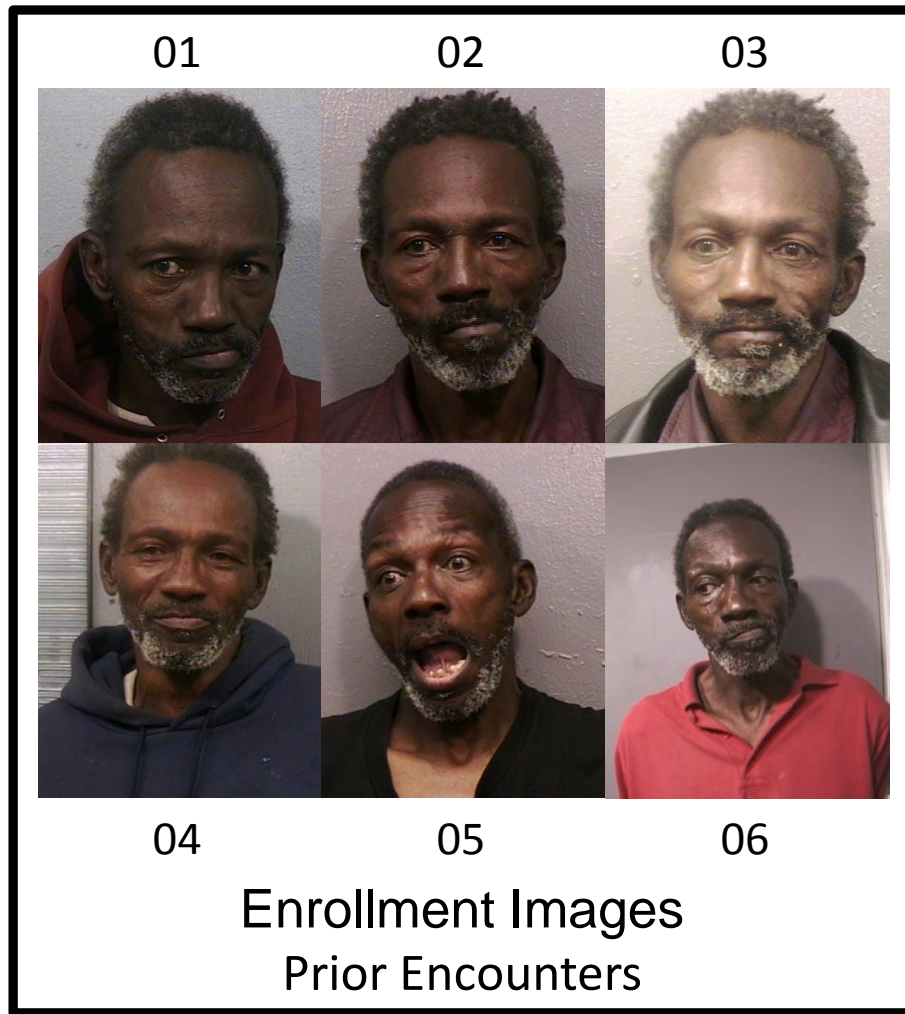
- » Camera + SOP
- » Illumination (sometimes)
- » Background (sometimes)
 - Need infrastructure mods

Accuracy Downside :: Webcam Images

1:N Accuracy, N = 1.6M Rank 1 Hit Rates	SDK	Photo File All	Photo File DHS Webcam	Photo File Without Webcam Estimated
L1	W22	0.88	0.54	0.93
MorphoTrak	Y21	0.83	0.39	0.89
Cognitec	X21	0.83	0.44	0.88
Pittsburgh Pattern Reco.	P22	0.65	0.35	0.69
NEC	V21	0.93	0.72	0.96

- » Approx 12% of the MBE-STILL Photo File data are Webcam images.
- » Error rates are 3 to 4 times higher on Webcam Images
- » Second round MBE-STILL algorithms, N = 1600000

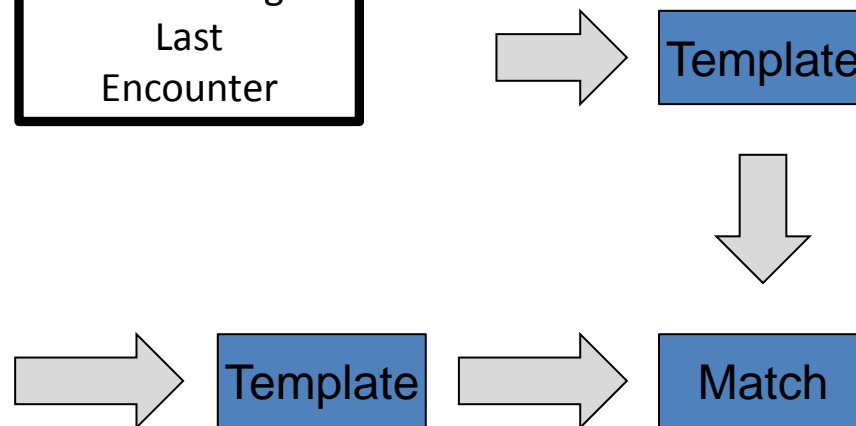
Multiple Encounters



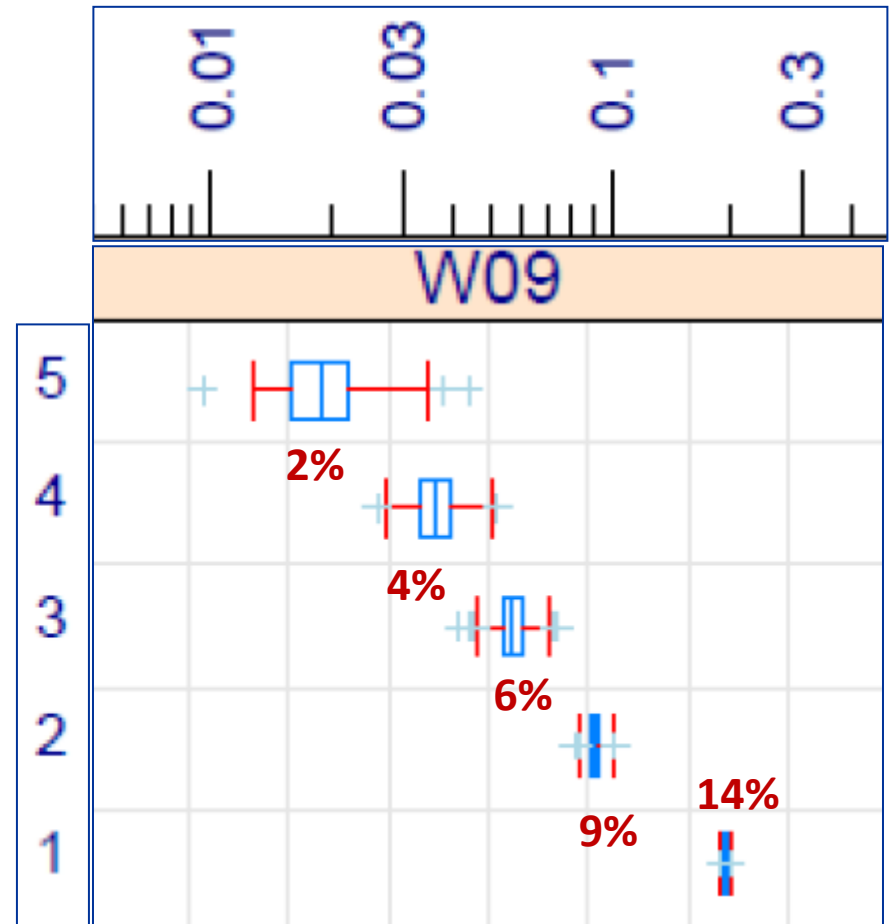
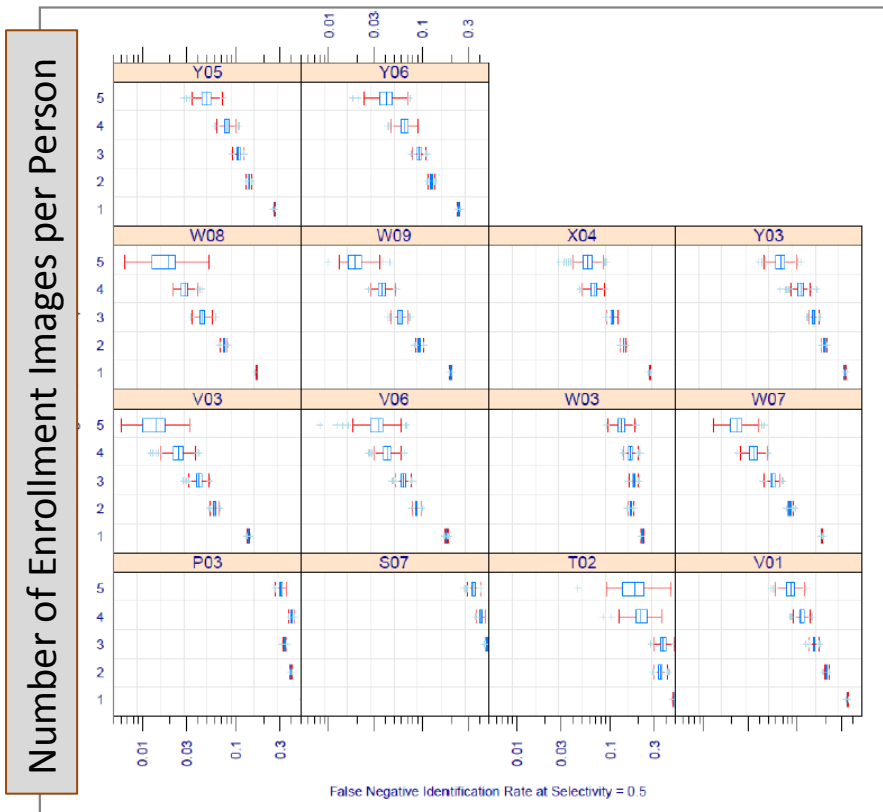
MEDS Example (S033)



Vendor
implemented
(template-level)
fusion



Multiple Encounters: Miss Rate Reduction

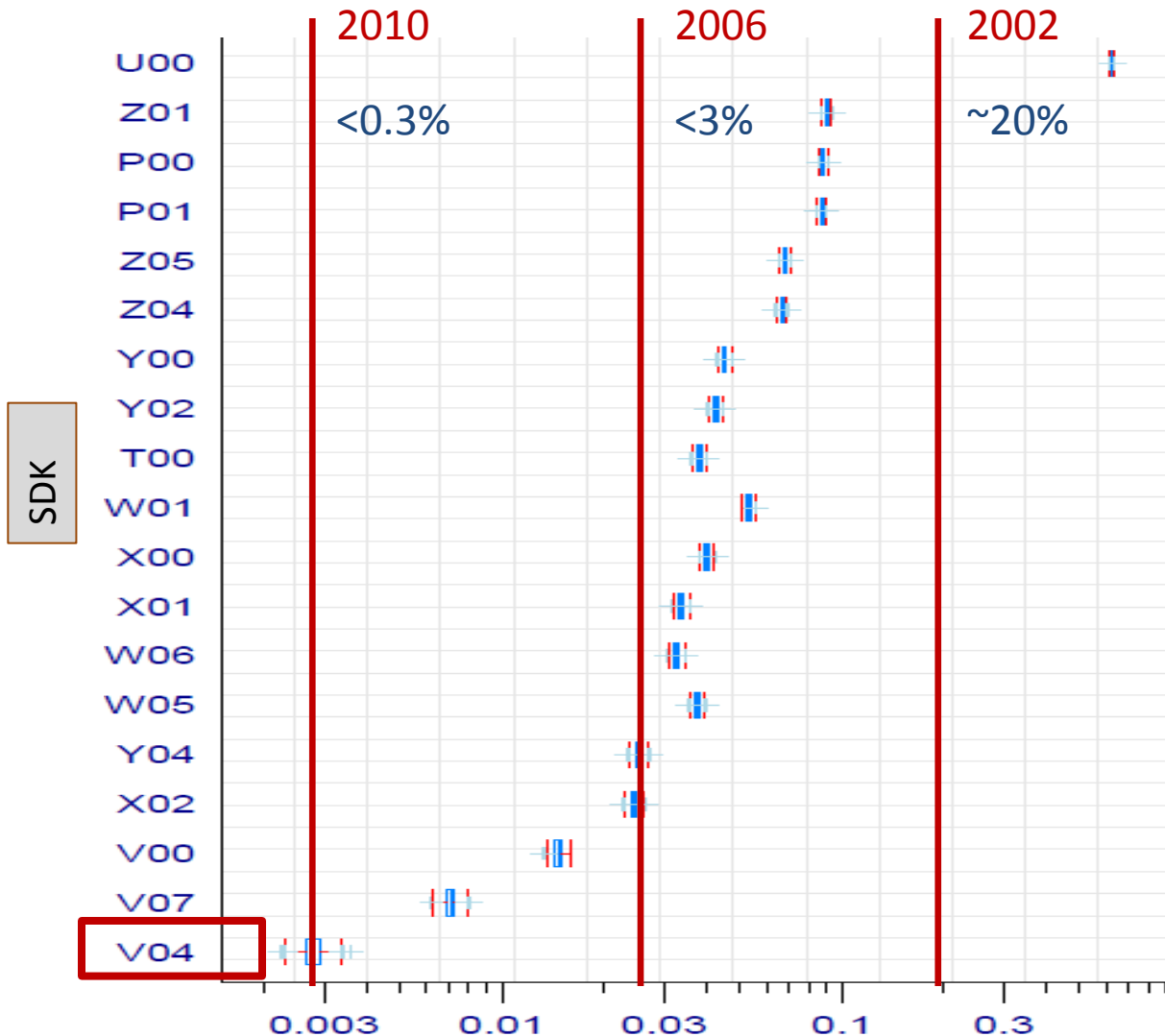


Enrolled Pop Size = 1.6M

Number of searches = 40K

Threshold set to give 0.5 false candidates per search, $SEL(T) = 0.5$

Fixed dataset used in three tests



» Red lines show best prior results in

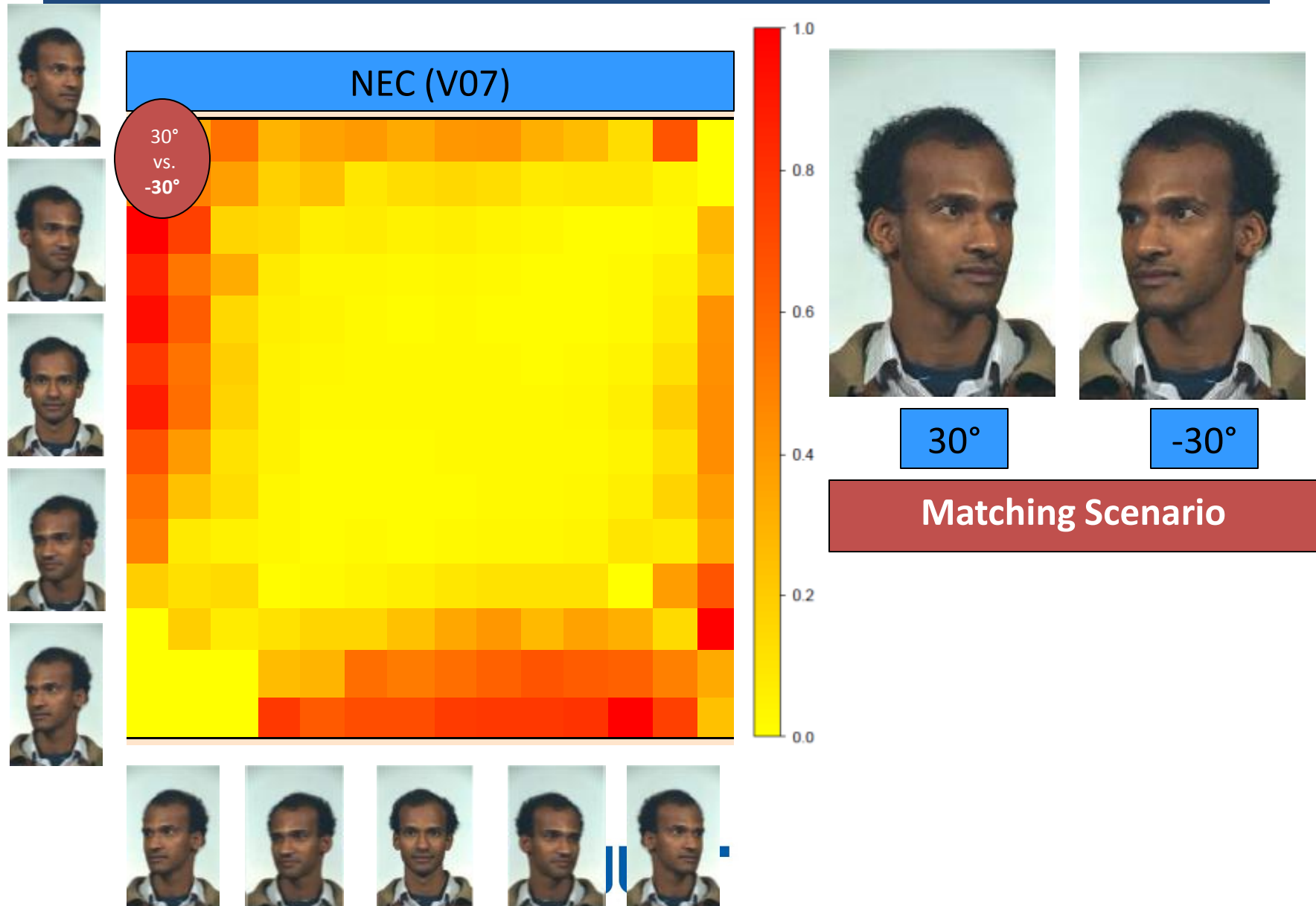
- FRVT 2002
- FRVT 2006
- MBE 2010

» Images

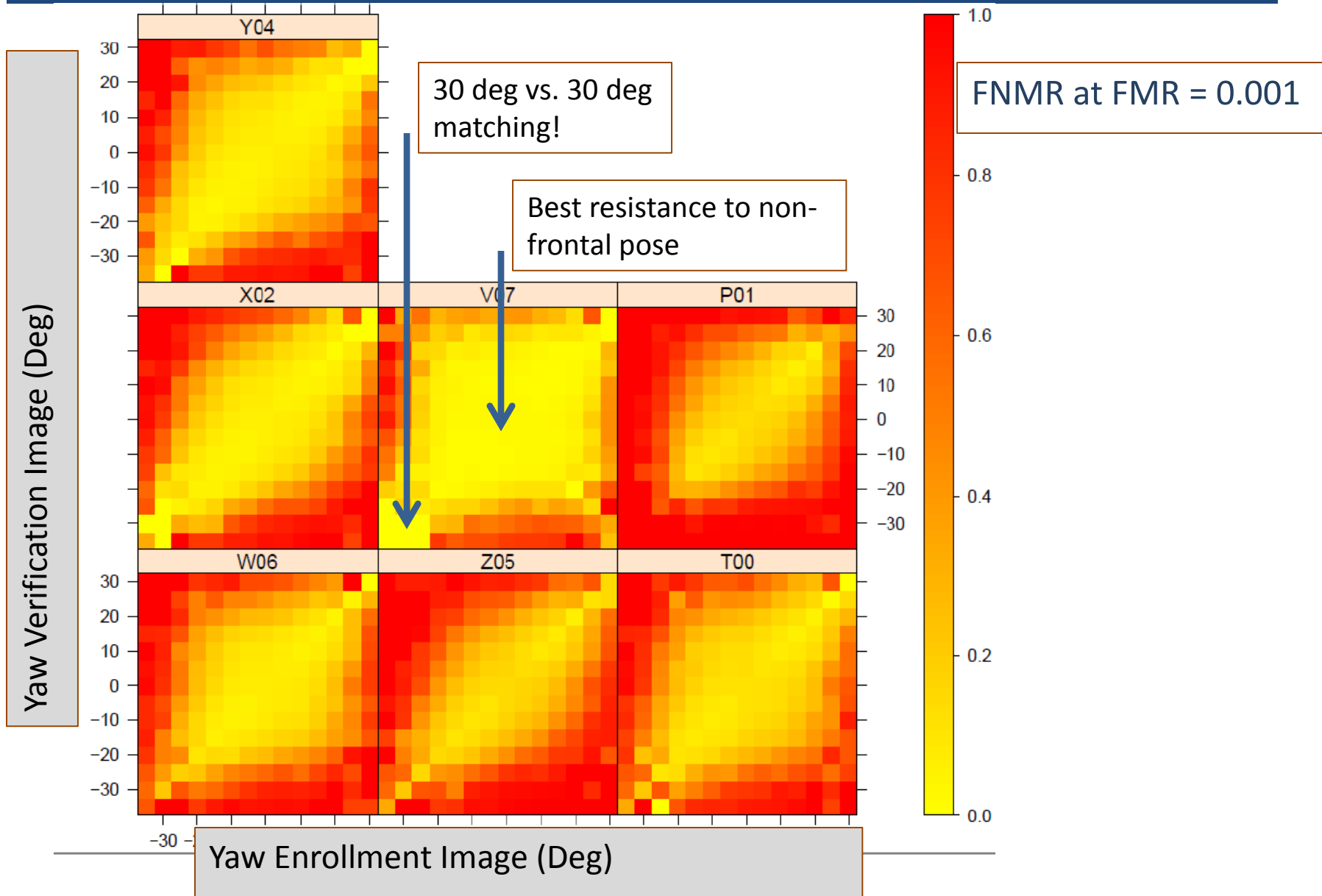
- DoS / FRVT 2002
- 121589 images
- 37437 persons
- 300 x 352 image size
- ~70 pixels eye-to-eye BUT
- JPEG compressed ~10K

False Non-Match Rate at False Match Rate = 0.001

Cross-Pose Matching



Cross-Pose Matching



Chapter III :: IREX

Selected Results from the Iris
Exchange (IREX) Program Supporting
IRIS Interoperability



Three IREX Activities

IREX I

- △ Formats, cropping, masking
- △ Compression limits
- △ Geometry, Margins, Radius
- △ Dilation, concentricity
- △ Concluded mid 2009
- △ Supported ISO/IEC 19794-6

IREX III

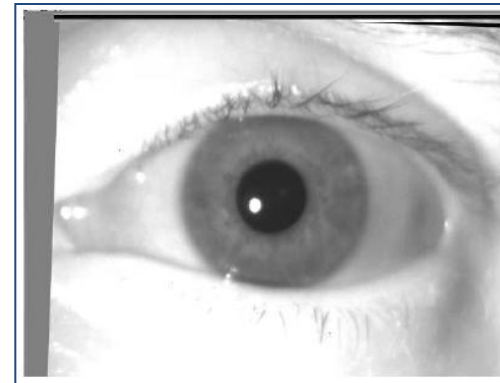
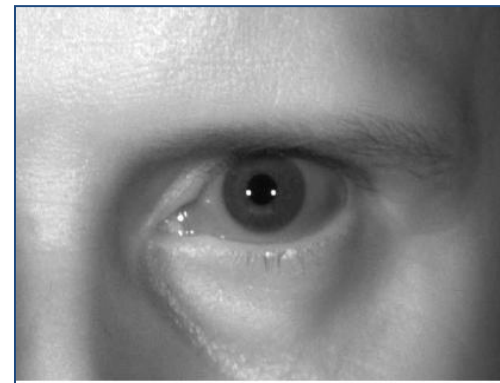
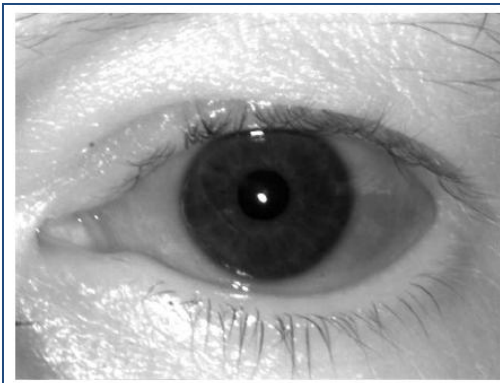
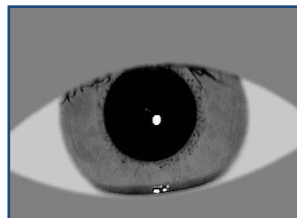
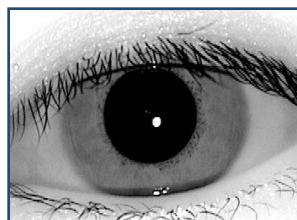
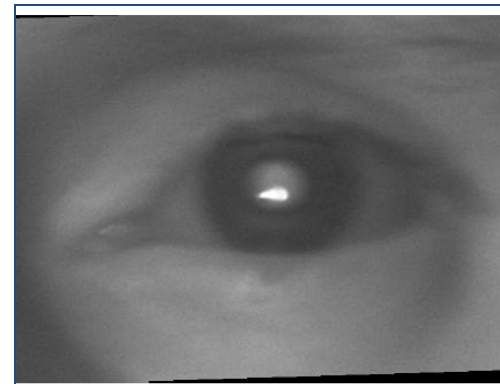
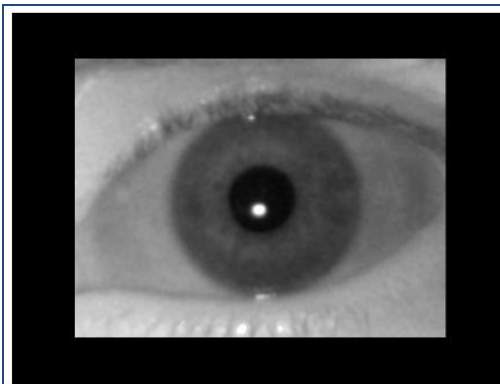
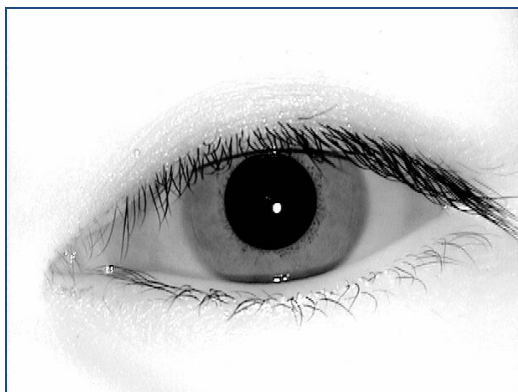
- △ 1:N with N in the millions
- △ One and two eyes
- △ Cross camera interop.
- △ Timeline
 - △ Started February 2011
 - △ Initial Report July 2011
- △ **Open call for images**



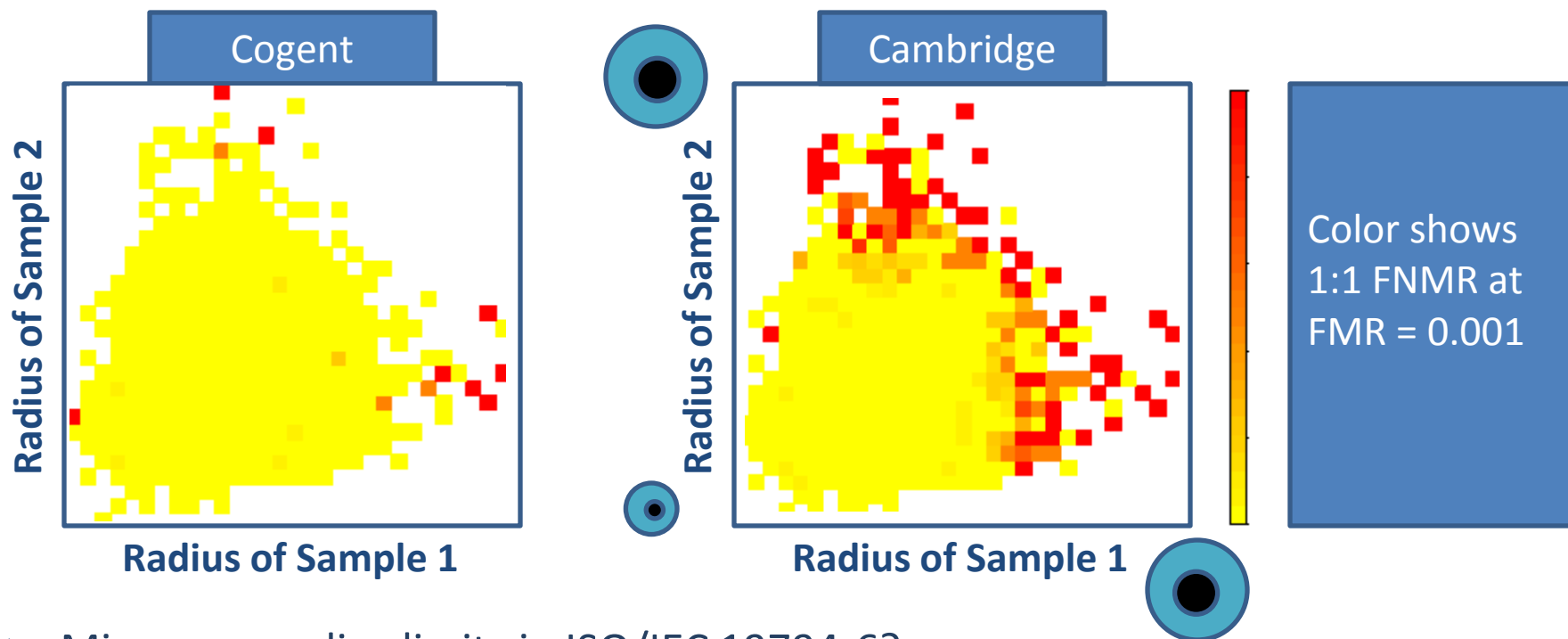
IREX II

- △ Iris Image Quality
 - △ Definition
 - △ Evaluation
 - △ Calibration
- △ Supporting ISO/IEC 29794-6
- △ Report Spring 2011

Irises :: One person, different images



Iris Recognition :: Standardize Radius?



- » Min + max radius limits in ISO/IEC 19794-6?
 - No, and the standard is nearing completion.
- » In an application profile
 - Yes, in the US Gov PIV program, which will include iris, Fall 2010.

Conclusions

- » NIST conducts quantitative testing of biometric algorithms
 - Open, free, worldwide
 - Face, Finger, Iris, Speaker, Latent
 - Very large scale
 - Repeatable, fair
 - Independent
 - Operational data (often)

- » NIST is active in biometric standardization
 - Face
 - Iris
 - Finger minutiae
 - Speaker
 - DNA
 - Image quality
 - SDO for ANSI/NIST ITL standard
 - Biometric Testing
 - Biometric Interfaces

- » Active Test Programs
 - Face :: MBE-STILL
 - Updated MBE Report, Spring 2011
 - Compression Report, Spring 2011
 - MBE
 - Video
 - Face + Iris
 - MINEX II
 - Match-on-card, Imminent
 - Iris :: IREX II
 - Image Quality Report, Spring 2011
 - Iris :: IREX III
 - One-to-many Report, Summer 2011
 - Latent fingerprint
 - Phase II report, March 2011
 - Phase III ongoing, Report Late 2011
 - MINEX
 - Minutia Interoperability, Ongoing
 - PFT
 - End-stage-matchers, Ongoing

Links

- » Feedback and further information:
 - patrick.grother@nist.gov
 - 301 975 4157
- » ANSI/NIST Standard
 - Workshop March 1-3
 - <http://fingerprint.nist.gov/standard>
- » Segmentation (SLAPSEG II)
 - <http://fingerprint.nist.gov/slapsegII>
- » Minutiae (MINEX)
 - <http://fingerprint.nist.gov/minex>
- » Match-on-Card (MINEX II)
 - <http://fingerprint.nist.gov/minexII>
- » Latent Matching (ELFT)
 - <http://fingerprint.nist.gov/latent>
- » Proprietary template fingerprint (PFT)
 - <http://fingerprint.nist.gov/pft>
- » Iris Exchange Test 2008 (IREX)
 - <http://iris.nist.gov/irex>
- » Video Face + Iris (MBGC)
 - <http://face.nist.gov/mbgc>
- » Standards activity
 - A/N
 - <http://fingerprint.nist.gov/standard>
 - ISO
 - <http://isotc.iso.org/livelink/livelink?func=ll&objid=8919152&objaction=ndocslst>